Final States in MicroBooNE

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July 12, 2012

Final State Tables

- Sam Zeller showed final state tables for Nuance MC events at last week's cross section meeting
- Have duplicated Sam's tables for Genie MC events generated using BNB flux in LArSoft
- Genie events had POT = 7.67×10^{20} - normalize to 6×10^{20} POT
- Genie events were generated in MicroBooNE active volume (122.466 metric tons) - normalize to 70 metric ton fiducial volume

Final State Tables for Genie Events

Experimental Signature	Event Rate (no energy cut)
1 μ + 0 p + 0 π	1,502
1 μ + 1 p + 0 π	42,192
1 μ + ≥2 p + 0 π	26,330
1 μ + 0 p + 1 π	4,865
1 μ + 1 p + 1 π	15,782
1 μ + ≥2 p + 1 π	13,079
1 μ + 0 p + ≥2 π	547
1 μ + 1 p + ≥2 π	1,769
other	44,025
total	150,090

- My event rates for final states in Genie
- These events may include any number of neutrons or de-excitation photons
- Normalized to 6×10^{20} POT and 70 metric ton fiducial volume

Final State Tables with no energy cut, compare to Nuance

Experimental Signature	Event Rate (Nuance)	Event Rate (Genie)
1 μ + 0 p + 0 π	5	1,502
1 μ + 1 p + 0 π	15,158	42,192
1 μ + ≥2 p + 0 π	44,283	26,330
1 μ + 0 p + 1 π	915	4,865
1 μ + 1 p + 1 π	3,993	15,782
1 μ + ≥2 p + 1 π	14,159	13,079
1 μ + 0 p + ≥2 π	320	547
1 μ + 1 p + ≥2 π	1,556	1,769
other	36,892	44,025
total	117,281	150,090

- Compare to Nuance event rates (from Sam Zeller's talk last week, doc db# 2055)
- Again, may include any number of neutrons or de-excitation photons
- 70 metric ton fiducial volume, 6×10^{20} POT

Final State Tables for Genie events
(with energy cut)

- Energy cut - require proton(s) to have KE ≥50MeV
- These events include 0 pions, and any number of neutrons and de-excitation photons

Experimental Signature	Event Rate (no energy cut)	Event Rate (50MeV proton KE cut)
1 μ + 0 p	1,502	24,724
1 μ + 1 p	42,192	35,914
1 μ ≥ 2 p	26,330	9,386

Final State Tables with energy cut, compare to Nuance

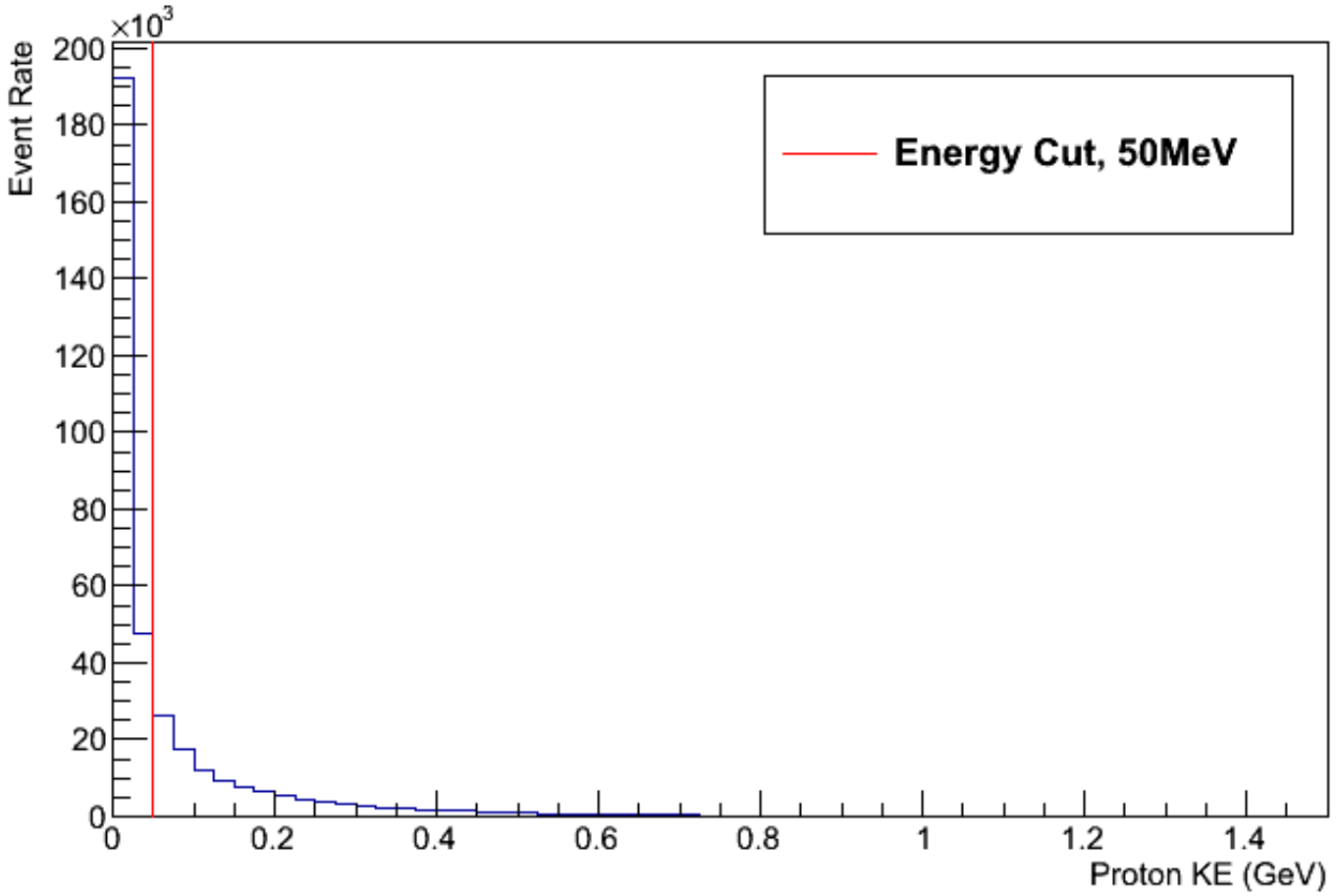
- Energy cut: proton KE ≥50MeV
- 0 pions, and any number of neutrons and de-excitation photons

Experimental Signature	Event Rate (Nuance)	Event Rate (Genie)
1 μ + 0 p	12,791	24,724
1 μ + 1 p	21,006	35,914
1 μ + 2 p	14,680	6,198
1 μ + 3 p	7,191	2,003
1 μ + ≥4 p	3,779	1,185

Cross Section Parameters

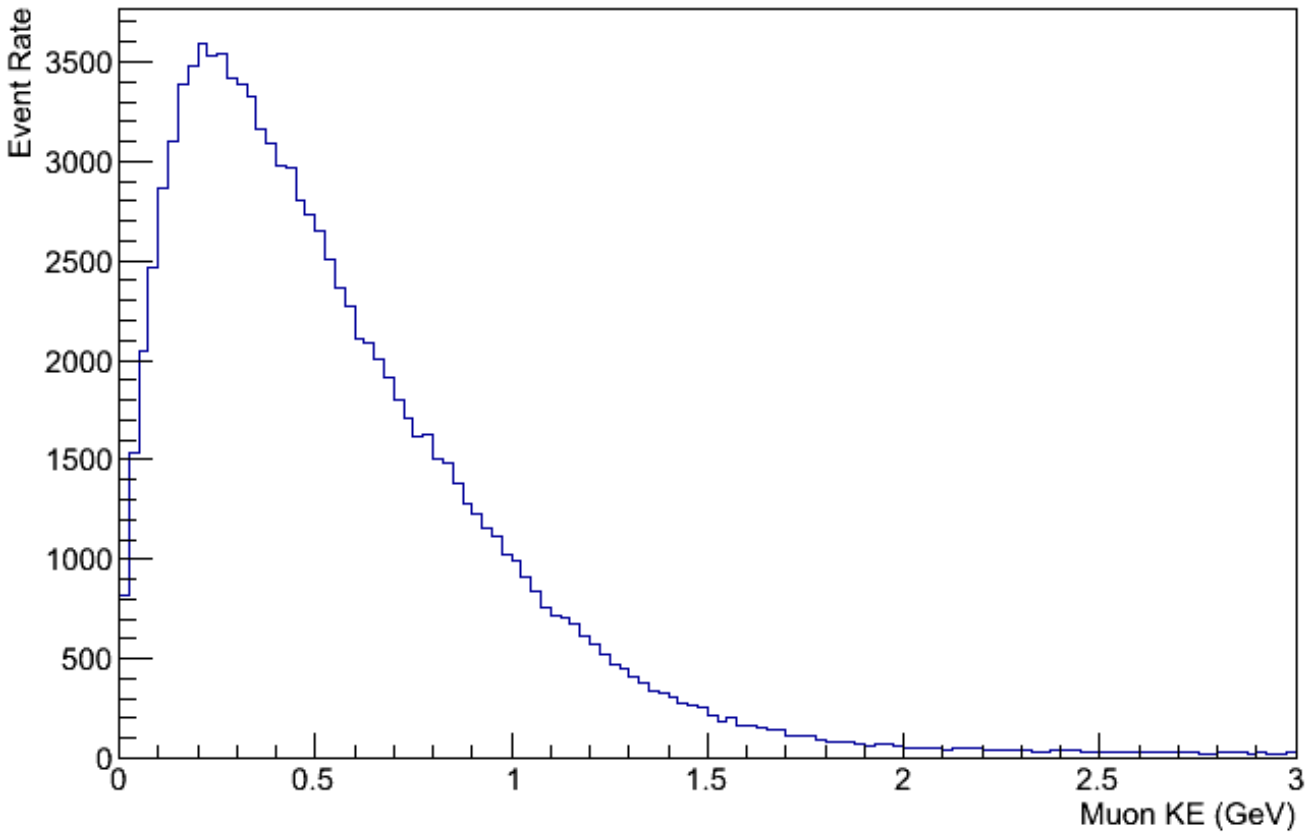
- Sam's Nuance events use MiniBooNE xsec parameters
- Genie events use xsec parameters of the Genie version that is included in LArSoft (don't yet know exactly what these are)

Proton energy distribution



- Also normalized to 6×10^{20} POT and 70t fiducial volume

Muon energy distribution



- Also normalized to 6×10^{20} POT and 70t fiducial volume

Coming soon …

Looking at ν_e signal and background final states

- Sorting MC events into a different set of samples looking at primary and secondary particles (all final states)
  - Muon samples: 1 μ, ≥2 μ
  - Electron samples: 1 e, ≥2 e
  - Photon samples: 1 γ, 2 γ, ≥3 γ
- Interested in backgrounds from 1 γ sample and 1 e sample